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Certification

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PATENT

8-20-01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of GABZDYL.
S/N: 09/844,186
Filed: April 27, 2001
For: "Improvements in Thermal Welding"
Atty. Dkt.: M00B107

Group: 1725

Assistant Commissioner for Patents
Washington, DC 20231

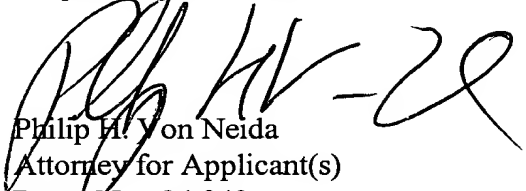
TRANSMITTAL OF CERTIFIED COPY

Attached please find the certified copy of the foreign application from which priority is claimed for the subject patent application.

Country: United Kingdom
Application No.: 0010793.8
Filing Date: May 3, 2000

Respectfully submitted,

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Intellectual Property Dept.
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CERTIFICATE OF MAILING (37 CFR 1.8)

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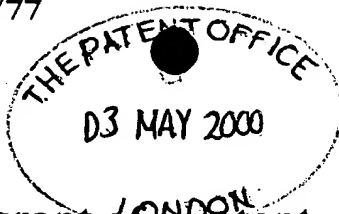
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Patent
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05MAY00 E534360-1 D02805
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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road

Newport

Gwent NP9 1RH

0010793.8

1. Your reference M00B107/RJB

2. Patent application number
(The Patent Office will fill in this part)

03 MAY 2000

3. Full name, address and postcode of the or of each applicant (underline all surnames)

The BOC Group plc, Chertsey Road, Windlesham, Surrey, GU20 6HJ

Patents ADP number (if you know it)

884627002

If the applicant is a corporate body, give the country/state of its incorporation

England

4. Title of the invention

Improvements in Thermal Welding

5. Name of your agent (if you have one)

Roger James Bousfield

"Address for service" in the United Kingdom to which all correspondence should be sent
(including the postcode)

The BOC Group plc, Chertsey Road, Windlesham, Surrey, GU20 6HJ

Patents ADP number (if you know it)

973131002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
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- | | |
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| Continuation sheets of this form | 0 |
| Description | 3 |
| Claim(s) | 1 |
| Abstract | 0 |
| Drawing(s) | 14-19 |

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| mainly against each item. | |
| Priority documents | 0 |
| Translations of priority documents | 0 |
| Statement of inventorship and right to grant of a patent (<i>Patents Form 7/77</i>) | 0 |
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Signature

Date
2 May 2000

Roger Bousfield
(01276) 477612

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IMPROVEMENTS IN THERMAL WELDING

The present invention relates to thermal welding processes and in particular to methods of cooling work pieces during a thermal welding process.

During the thermal welding of metallic work pieces a high heat input is required to generate an acceptable weld. However, this high heat input has the disadvantage that it can cause significant levels of distortion of the work pieces being welded.

It is known to use gases to provide forced cooling during thermal welding processes. However, the results of using cooling gases are limited as the cooling ability of the gas streams is relatively low.

It is an aim of the present invention to utilise a jet of a cryogenic liquid or cryogenic solid to cool a thermal welding process.

According to the present invention a method of thermal welding together at least two metallic work pieces comprises the steps of applying heat at a welding zone for welding together the two work pieces; and applying at or adjacent the welding zone at least one jet of a cryogen.

The cryogen may be in the form of a liquid cryogen, for example, liquid nitrogen or liquid argon. Alternatively, the cryogen may be solid carbon dioxide.

Preferably the cryogen is applied to the welding zone through a plurality of nozzles.

Embodiments of the invention will now be described, by way of example, reference being made to the Figures of the accompanying diagrammatic drawings in which:

Figure 1 is a sketch of two metallic plates being butt welded together according to the present invention; and

Figure 2 is a sketch showing two metallic plates being fillet welded together according to the present invention.

Referring first to Figure 1, two metallic plates 1, 2 to be butt welded together are placed as shown side by side and a thermal welding torch 4 is positioned at the abutting surfaces of the two plates. The torch is energised in a manner known per se and heat is applied to the welding zone along the abutment of the two metal plates. At the same time a cryogen is applied to the welding zone in the form of two jets 6, 7 which pass respectively through nozzles 8, 9.

The cryogen may be a liquid cryogen for example liquid nitrogen or liquid argon. Alternatively the cryogen could be solid carbon dioxide or a mixture of solid carbon dioxide together with a liquid cryogen.

Referring now to Figure 2 where the two metal plates 11, 12 are to be fillet welded. Heat is applied to a welding zone via a torch 13 to provide sufficient heat for the welding process to take place. Simultaneously a cryogen is applied in the form of jets 15 to the general area of the welding zone via nozzles 16, 17, 18.

It has been found that by using a cryogen to cool the metallic components being welded the following effects have been observed:

- a) the reduction or control the level of distortion;
- b) the protection of heat sensitive components near the welding zone;
- c) the reduction of the effects of chemical degradation as a result of heat; and
- d) the control of metallurgical properties (ie control of grain growth).

The choice of the cryogen is dependent on the process and the material of the metallic plates being welded. The amount of cooling and location to which the cryogen is applied is strictly controlled in order to achieve the desired effect. This is achieved by applying the cryogen via a nozzle or nozzles directed on to the surface of the work pieces being welded. The size and geometry of the nozzles is a critical factor for controlling the cooling footprint as well as the location and orientation of the cooling jets. It is critical that the jets of cryogen do not interfere with the welding operation.

Example

When butt welding two aluminium alloy plates each 3mm thick, a cryogen of solid carbon dioxide was applied as a jet on the lower (root) side of the weld, trailing the welding point by approximately 20mm and at a stand off distance of 20mm. A 1mm diameter nozzle was used with a carbon dioxide consumption of approximately 1.5kg/min with a supply pressure of 22bar. This method was compared with tungsten inert gas (TIG) welding using a gaseous argon cooling flow of 40 litres/min.

Measuring the temperature at approximately 40mm from the weld line; with the argon gas cooling the temperature was 300°C. Whilst with the carbon dioxide cooling the temperature was only 100°C. The benefit of the lower temperature was the reduction in distortion in the order of 80% to 90%.

This method is applicable to various thermal welding processes, for example, Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW) laser welding and friction stir welding.

CLAIMS

1. A method of thermal welding together at least two metallic work pieces comprising the steps of applying heat at a welding zone for welding together the two work pieces, and applying at or adjacent the welding zone a cryogen in the form of at least one jet.
2. A method as claimed in Claim 1, in which the cryogen is a liquid cryogen.
3. A method as claimed in Claim 2, in which the liquid cryogen is nitrogen.
4. A method as claimed in Claim 2, in which the liquid cryogen is argon.
5. A method as claimed in Claim 1, in which the cryogen is solid carbon dioxide.
6. A method as claimed in Claim 1, in which the cryogen is a mixture of solid carbon dioxide and a liquid cryogen.
7. A method of thermal welding together at least two metallic work pieces substantially as hereinbefore described with reference to and as illustrated in the Figures of the accompanying drawings.

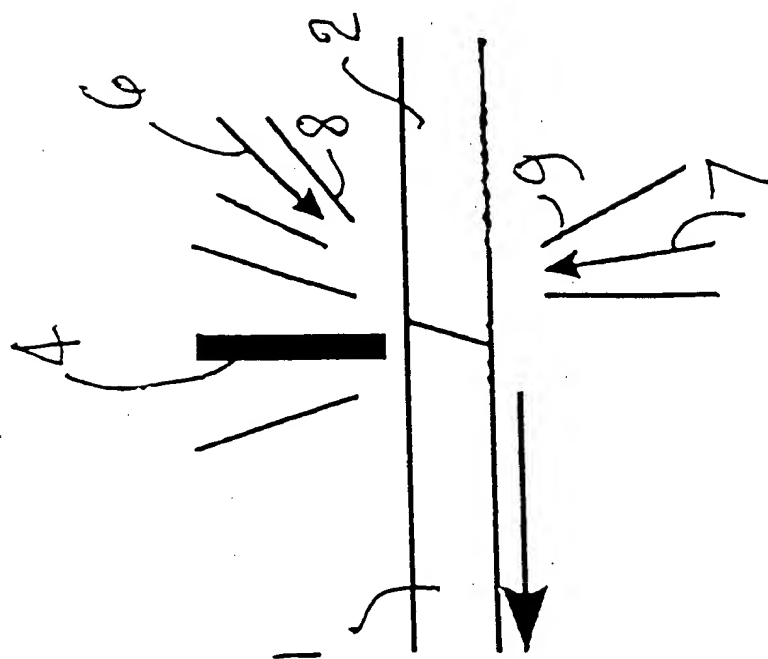


FIGURE 1

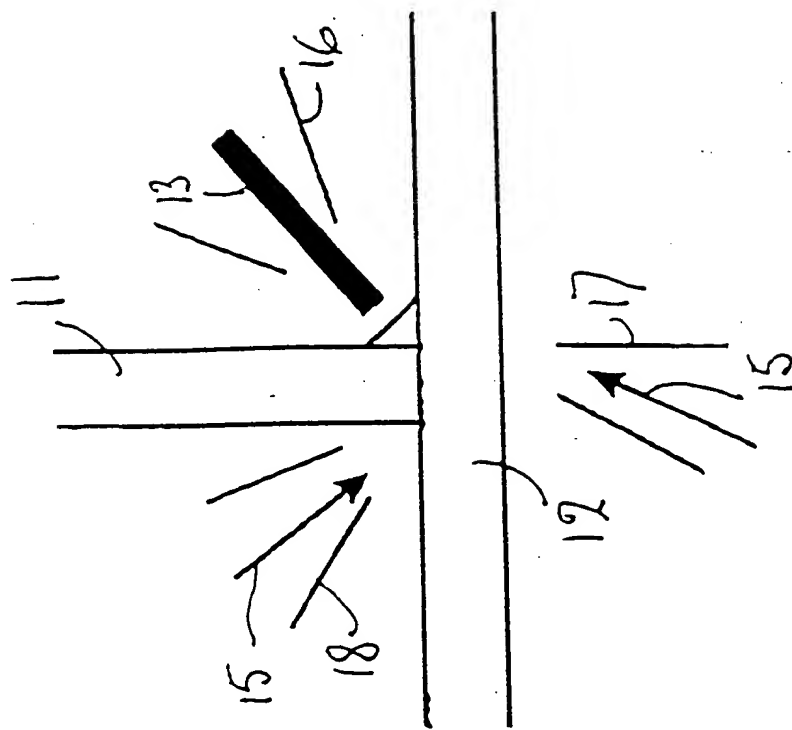


FIGURE 2

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